Non-invasive volume estimation of fish fillets/cutlets using structured light

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Non-invasive volume estimation of fish fillets/cutlets using structured light

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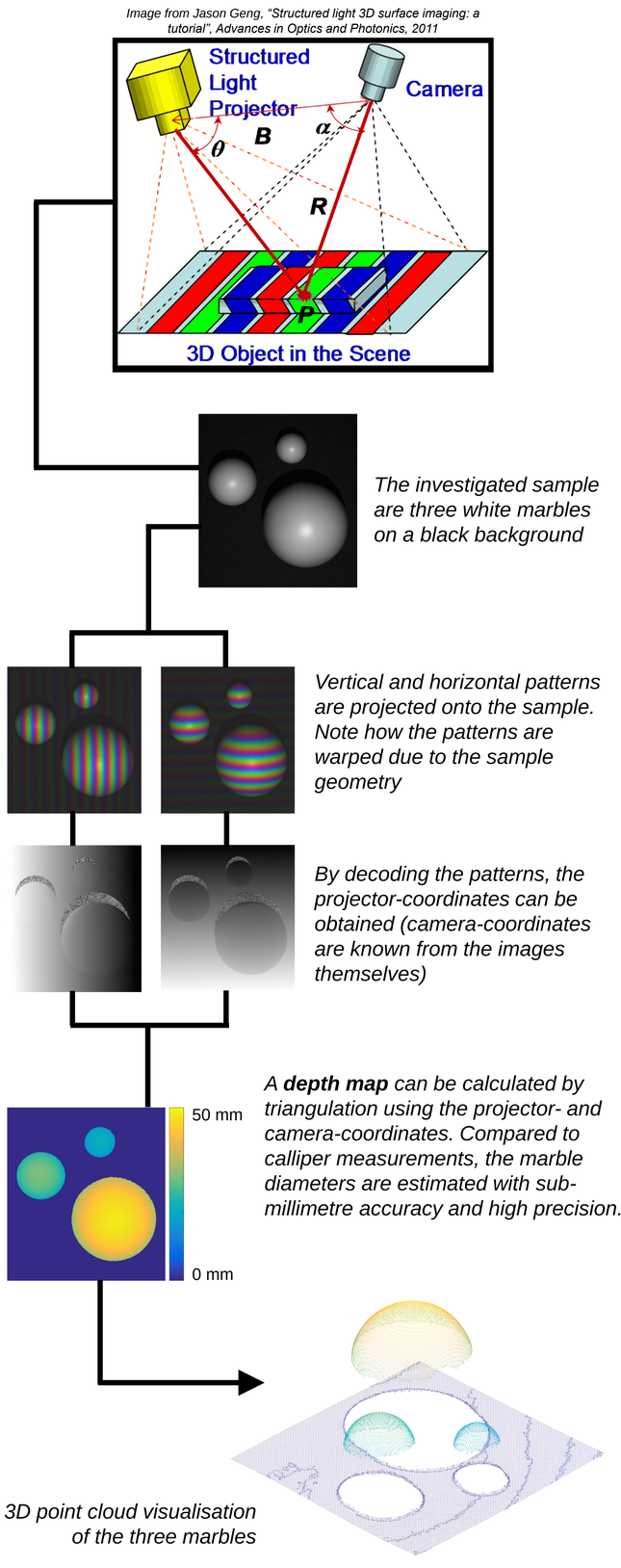
Structured light 3D scanning is an established technique for measuring the 3D geometry of a static scene. The technique only requires a projector and camera whose relative position in space is known (i.e. they are calibrated). **The basic principle** is that point-correspondences are established between camera and projector, from which depth information can be extracted through triangulation.

The structured light pipeline is illustrated and explained in **Fig. 1** where the geometry of three matte white marbles (spheres) is scanned. From the depth information the marble diameters can be estimated with **sub-millimetre accuracy**.

Fig. 1 structured light 3D scanning pipeline



Shrinkage is commonplace in many food processes, e.g. salting and heating where water is expelled from the product. However, the geometric changes due to shrinkage can be very difficult to measure manually. The aim of this study was to investigate if structured light 3D scanning is suitable for quantifying the shrinkage during dry-salting of herring fillets. This would allow for formulation/validation of novel salt diffusion simulation models, that incorporate changing geometry.

Dry-salting was carried out on a single herring (clupea harengus) fillet, where salt was added to both sides of the fillet. Structured light measurements were acquired after 0, 10, 20, 30, 40, 50, 60, 180, and 1440 minutes. Before each measurements the fillet was rinsed in water and the surface was dried afterwards using paper towels.

Fig. 2 presents the red-green-blue (RGB) **images of the dry-salting process** as well as the corresponding depth maps estimated by structured light. While some geometric changes can be observed (especially the length of the fillet), the subtle details can be hard to see. Also, note the colour changes that occur during the salting process (RGB images).

Thus, **Fig. 3** depicts some of the **quantified geometrical changes** that can be extracted from the depth maps through various image analysis techniques.

From the depth maps in **Fig. 2** an **issue** can be observed. Looking at the left side of the fillet, the height changes quite a lot between time steps, which affects the volume estimates in **Fig. 3**. This was found to be due to the left side slightly bending upwards. Thus, handling of the fillets needs to be standardised, as such variations can easily confound the shrinkage effects.

Fig. 2 images depicting the shrinkage

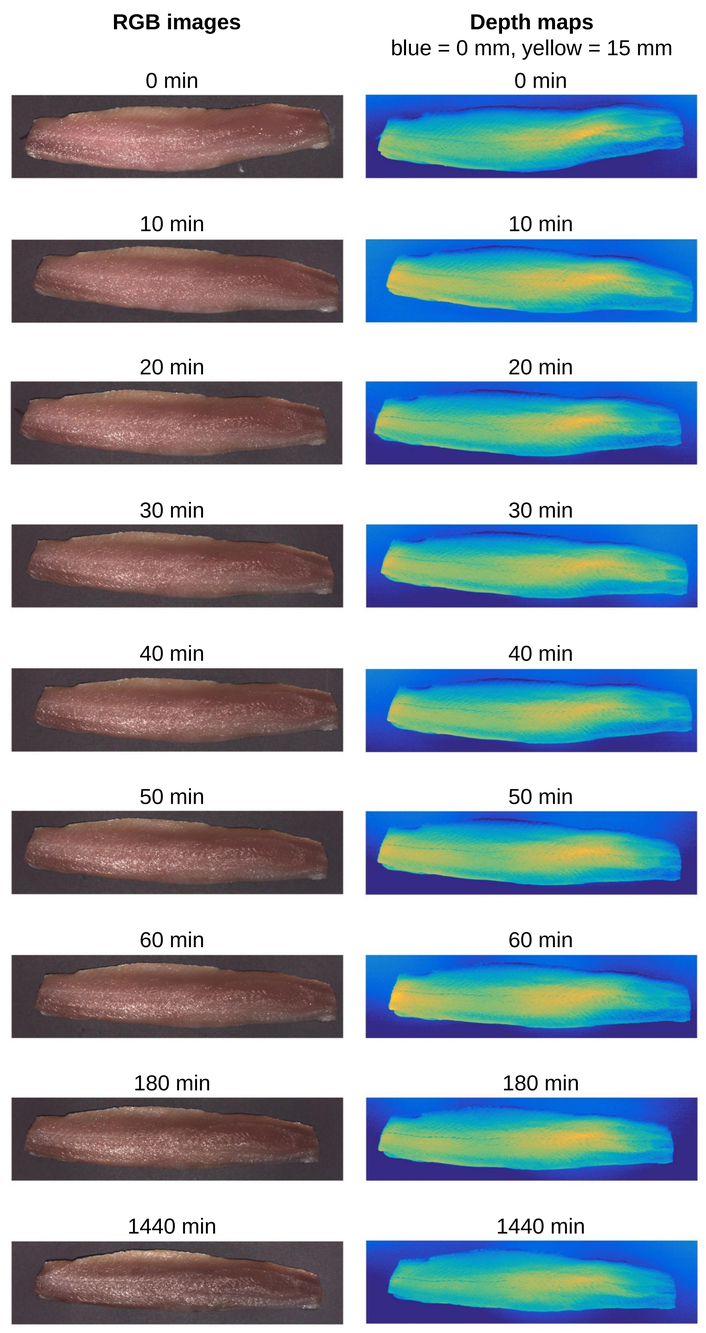
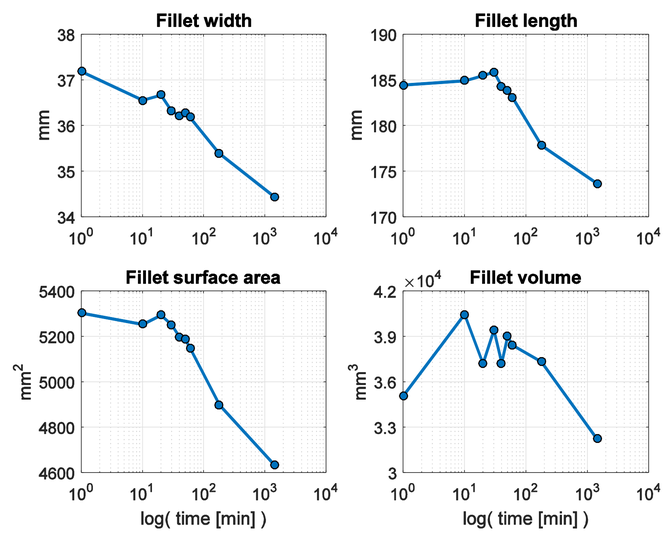


Fig. 3 quantified geometrical changes



Conclusions and perspectives. Based on the presented results, structured light 3D scanning will be investigated further for quantifying the shrinkage effects during salting of fish fillets. Apart from the raised issue, there will be an increased emphasis on quantifying more local geometrical changes, as well as the apparent colour changes that occurs during the salting process.

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